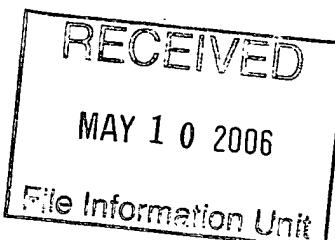


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08/049,147	4/19/93

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United States Patent Application Publication No. \_\_\_\_\_, page, \_\_\_\_\_ line \_\_\_\_\_

United States Patent Number 6,547,780, column \_\_\_\_\_, line, \_\_\_\_\_ or

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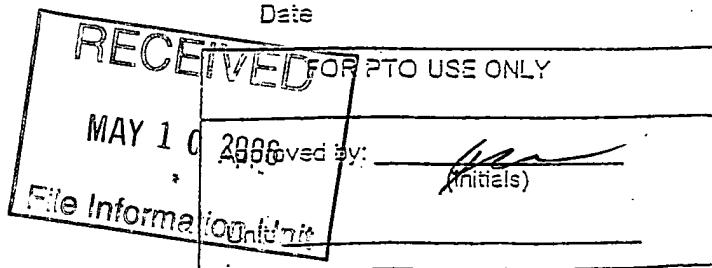
Rich Teskey  
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5/10/06

Date





US006547780B1

(12) **United States Patent**  
Sinofsky

(10) Patent No.: **US 6,547,780 B1**  
(45) Date of Patent: **\*Apr. 15, 2003**

(54) **INFRARED LASER CATHETER SYSTEM**(75) Inventor: **Edward Lawrence Sinofsky, Reading, MA (US)**(73) Assignee: **CardioFocus, Inc., Norton, MA (US)**

(\*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **09/201,072**(22) Filed: **Nov. 30, 1998****Related U.S. Application Data**

(63) Continuation of application No. 08/411,581, filed on Mar. 29, 1995, now Pat. No. 5,843,073, which is a continuation of application No. 08/049,147, filed on Apr. 19, 1993, now abandoned, which is a division of application No. 07/568,348, filed on Aug. 15, 1990, which is a continuation of application No. 07/257,760, filed on Oct. 14, 1988, now Pat. No. 4,950,266, which is a continuation of application No. 07/014,990, filed on Feb. 17, 1987, now abandoned, which is a continuation of application No. 06/761,188, filed on Jul. 31, 1985, now abandoned.

(51) Int. Cl.<sup>7</sup> ..... **A61B 18/28**(52) U.S. Cl. ..... **606/10; 606/3; 606/7;**  
..... **606/13**(58) Field of Search ..... **606/3, 7, 10-17****References Cited****U.S. PATENT DOCUMENTS**

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(List continued on next page.)

**Primary Examiner**—David M. Shay**(74) Attorney, Agent, or Firm**—Thomas J. Engellenner; Nutter McClenen & Fish LLP**(57) ABSTRACT**

Laser energy produced by a laser operating in the mid-infrared region (approximately 2 micrometers) is delivered by an optical fiber in a catheter to a surgical site for biological tissue removal and repair. Disclosed laser sources which have an output wavelength in this region include: Holmium-doped Yttrium Aluminum Garnet (Ho:YAG), Holmium-doped Yttrium Lithium Fluoride (Ho:YLF), Erbium-doped YAG, Erbium-doped YLF and Thulium-doped YAG. For tissue removal, the lasers are operated with relatively long pulses at energy levels of approximately 1 joule per pulse. For tissue repair, the lasers are operated in a continuous wave mode at low power. Laser output energy is applied to a silica-based optical fiber which has been specially purified to reduce the hydroxyl-ion concentration to a low level. The catheter may be comprised of a single optical fiber or a plurality of optical fibers arranged to give overlapping output patterns for large area coverage.

**14 Claims, 6 Drawing Sheets**